

Comparison of Estimated Glomerular Filtration Rate Using Five Equations to Predict Acute Kidney Injury Following Total Joint Arthroplasty

Hunter M. Hayes, D.O.²; Kevin L. Mekkawy, D.O.¹, Yash P. Chaudhry, D.O.²; Sandesh S. Rao, M.D.¹; Micheal Raad, M.D.¹, Raj M. Amin, M.D.³; Harpal S. Khanuja, M.D.¹

¹ Department of Orthopaedic Surgery, Johns Hopkins University School of Medicine, Baltimore, MD, USA;

² Department of Orthopaedic Surgery, Philadelphia College of Osteopathic Medicine, Philadelphia, PA, USA

³ Department of Orthopaedic Surgery, Stanford University Medical Center, Palo Alto, CA, USA

Introduction

- Acute kidney injury (AKI) following total joint arthroplasty (TJA) is associated with increased morbidity and mortality¹
- Estimated glomerular filtration rate (eGFR) is used as an indicator of renal function
- Several equations are commonly used to calculate eGFR²
- The purpose of this study was 1) to evaluate the agreement between five equations in calculating eGFR, and 2) to confirm which equation can best predict postoperative AKI in patients undergoing TJA.

Materials and Methods

- 479,261 cases of TJA were queried from the National Surgical Quality Improvement Program (NSQIP) from 2012 to 2019
- Preoperative eGFR was calculated using the Cockcroft-Gault (CG), Modification of Diet in Renal Disease (MDRD) II, re-expressed MDRD II, Chronic Kidney Disease Epidemiology Collaboration, and Mayo quadratic (Mayo) equations
- The primary outcome measure was AKI
- Cases were stratified into two cohorts based on the development of postoperative AKI
- These cohorts were compared based on demographic and preoperative factors
- Multivariate regression analysis was used to evaluate independent associations between preoperative eGFR and postoperative renal outcomes

Results

	CG	MDRD II	Re-expressed MDRD II	CKD-EPI	Mayo
Mean eGFR	98.6 ± 32.7	86.6 ± 26.4	75.1 ± 28.8	91.6 ± 17.1	97.3 ± 19.6
≥90	286,132 (58)	203,028 (41)	115,455 (23)	283,794 (57)	351,417 (71)
≥60, <90	163,614 (33)	233,171 (47)	226,453 (46)	191,771 (39)	122,585 (25)
≥45, <60	34,820 (7.0)	45,253 (9.1)	107,606 (22)	15,663 (3.2)	14,332 (2.9)
≥30, <45	10,868 (2.2)	13,206 (2.7)	40,494 (8.1)	4,864 (1.0)	6,404 (1.3)
≥30, <15	1,517 (0.3)	2,185 (0.4)	6,666 (1.3)	959 (0.2)	2,021 (0.4)
≤15	310 (0.1)	418 (0.1)	587 (0.1)	210 (0.0)	502 (0.1)

Table 1. Distribution of patients by preoperative eGFR based off each of the five equations.

Equation	Acute Kidney Injury			
	Odds Ratio (95%CI)	P-value	AIC	AUC
CG	0.78 (0.75- 0.82)	<0.001	6588	0.689
MDRD II	0.78 (0.74- 0.82)	<0.001	6599	0.721
Re-Expressed MDRD II	0.86 (0.82- 0.90)	<0.001	6660	0.658
CKD-EPI	0.75 (0.71- 0.80)	<0.001	6628	0.707
Mayo	0.74 (0.70- 0.78)	<0.001	6546	0.712

Table 2. Logistic Regression Analysis of Odds of Developing AKI by Each of the Five Equations

- Seven hundred sixty-seven (0.16%) patients acquired AKI after TJA
- The Cockcroft-Gault equation yielded the highest mean eGFR (98.6 ± 32.7), while the Re-expressed MDRD II equation yielded the lowest mean eGFR (75.1 ± 28.8). (**Table 1**)
- Multivariate regression analysis showed that a decrease in preoperative eGFR was independently associated with an increased risk of postoperative AKI in all five equations (**Table 2**)
- The Akaike information criterion (AIC) was the lowest in the Mayo equation (6546) (**Table 2**)

Conclusions

- Preoperative decrease in eGFR in all five equations was independently associated with increased risk of postoperative AKI
- The Mayo equation had the highest predictive ability of acquiring postoperative AKI following hip fracture surgery
- Understanding which equation may best capture the patients at highest risk of developing AKI may help providers make decisions on perioperative management in these patients

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